

**WATER-IN-OIL ANALYZER  
PREPRODUCTION INITIATIVE  
ADDENDUM TO WATER-IN-OIL ANALYZER TEST PLAN**

**SITE: NAVAIR PATUXENT RIVER LABORATORY**

**1.0 OBJECTIVE**

The objective of this Pollution Prevention Equipment Program (PPEP) Preproduction Initiative is to determine the feasibility of reducing the hazardous materials used and hazardous waste generated by analyzing lubricating and hydraulic oils for water content using various water-in-oil analyzer methods. In coordination with the Hand-held Water-in-Oil Analyzer Preproduction Initiative, the Navy will evaluate the feasibility of utilizing a chemical-free *laboratory* method of measuring water content in oils. This test plan will address the specific procedures that will be used to determine the chemical-free laboratory water-in-oil analyzer's ability to accurately determine the water content of Navy lubricating and hydraulic oils.

The chemical-free laboratory water-in-oil analyzer will be tested in a Navy laboratory setting for its ability to replace the automated Karl Fischer coulometric titrator (Aquatest 8)—the standard method for determining water content in oils (e.g., MIL-L-83282 and MIL-H-17111). Additionally, the test results will be compared to a hand-held water-in-oil analyzer. For a more detailed description of the hand-held water-in-oil analyzer, refer to the Water-in-Oil Analyzer Preproduction Initiative Test Plan under separate cover. Specifically, the unit will be evaluated for its ability to:

- Accurately determine the water concentration in lubricating, hydraulic, and cooling oils with respect to the Aquatest 8 standard.
- Reduce or eliminate labor associated with the laboratory analysis of water content in oils.
- Reduce or eliminate hazardous materials associated with standard laboratory methods.
- Reduce the quantity and disposal cost of hazardous waste generated by the laboratory analysis of the water content of lubricating, hydraulic, and cooling oils.

**2.0 DESCRIPTION**

As part of an ongoing effort to eliminate waste and reduce pollution, the Navy has been exploring the feasibility of utilizing chemical-free laboratory test methods. Currently, the Navy uses the Karl Fischer coulometric titration test method to measure low levels of moisture content in oils. During the titration, a chemical reaction takes place between iodine and the unknown quantity of water in the oil sample, causing an electric current (measured in coulombs) to be generated. When the titration reaches its end point (i.e., all of the water content has reacted with the iodine), the test equipment calculates the total

amount of current generated and time (in seconds) it took to complete the titration. This equates to the quantity of iodine used; and, since iodine and water react in a 1:1 ratio with each other, the quantity of iodine equals the quantity of water in the sample. Hazardous materials used to support the Karl Fisher method include the flammable Karl Fisher solution and nitric acid cleaning solutions. For this test method, analysis requires, on average, 14 minutes per sample, including instrument warmup time, routine instrument maintenance, and analysis of the sample. The chemical-free method selected for testing by PPEP uses no chemicals to determine the water content in oils, so there are no toxic reagents or hazardous waste disposal costs. The PPEP method may also reduce the time and level of difficulty to conduct the test.

### **3.0 TEST PLAN**

This test plan is designed to collect data that will be used to evaluate the efficiency, effectiveness, and performance of the chemical-free laboratory water-in-oil analyzer, as well as its compatibility with Navy operations. The test plan will also quantify the capital and operating costs of the analyzer and the waste reductions achieved.

The Computrac® VaporPro Moisture Analyzer, manufactured by Arizona Instruments, has been selected for evaluation in this test. The VaporPro will be evaluated at the NAVAIR Patuxent River (PAX) Fuels and Lubricants Laboratory to determine if it is capable of replacing analysis done with the Aquatest 8 system currently used to analyze the water content of oil samples. The VaporPro is capable of analyzing water concentrations in oils and displays results in “percent moisture,” “parts per million,” and “micrograms of water.” The unit will be evaluated for use in laboratories ashore or afloat. The VaporPro operates automatically by menu-driven prompts and requires minimal user skills.

***If repairs to the VaporPro are required at any time during the test period, they are to be arranged through PPEP, not the vendors. Call Geneen McQuaid (856-667-6770, x132) or Raymond Wendrzycki (732-323-1666 or DSN 624-1666) if any consumables or repairs are required for the VaporPro.***

#### **3.1 Approach**

The VaporPro will be evaluated for accuracy, repeatability of results, ease of use, labor cost savings, reduction of hazardous material usage, and reduction of hazardous waste generation. Laboratory personnel will analyze various oil samples using the VaporPro chemical-free laboratory water-in-oil analyzer, the Pall TD513 hand-held analyzer, and the Aquatest 8 standard test method. In addition to analytical results, personnel will record data related to material usage, waste generation, maintenance requirements and reliability, and labor requirements for all methods. These data will be combined with user comments on ease of operation to determine the applicability of the VaporPro moisture analyzer in a Navy laboratory setting.

NAVAIR PAX will test for accuracy and repeatability of results in the following oils:

- MIL-L-85734 - transmission fluid
- MIL-PRF-83232 - hydraulic fluid
- MIL-PRF-87252 - coolant fluid
- MIL-H-17111 - hydraulic oil

To determine accuracy and repeatability, some lab samples will be tested as they come in from the fleet with unknown water concentrations. To determine the VaporPro moisture analyzer's range of effective operation, additional oil samples will be "spiked" with varying quantities of water. All samples will be tested with the VaporPro moisture analyzer and then tested with the Aquatest 8 method to correlate the resultant water content.

## 3.2 Data Collection

Data from this testing will be recorded on the supplied data sheet (Table L1). The Maintenance, Repair, and Cleaning Log (Table L2) will be completed when an equipment failure or scheduled maintenance occurs.

### 3.2.1 *Instructions for Completing the Laboratory Water-in-Oil Analyzer Data Sheet (Table L1)*

- **Laboratory:** Identify which laboratory is conducting the analysis.
- **Date:** Identify the date on which the sample is being analyzed.
- **Analyst:** Identify the person conducting the analysis.
- **Sample ID:** Create a unique sequence sample identification number. If the sample was shipped to the lab from the fleet or from the Helicopter Transmission Fluid Purifier Unit (HTFPU) program, the sample ID should reflect the one assigned by the shipper. Note: Please refer to the HTFPU Preproduction Initiative, which is being conducted in conjunction with the Water-in-Oil Analyzer Preproduction Initiative, for more information.
- **Type of Oil:** Identify by specification number (e.g., MIL-L-83282, MIL-H-17111) the type of oil being analyzed.
- **Type of Sample (F/H/S):** Identify whether the sample is from the fleet (F), the HTFPU program (H), or if the sample was spiked by the laboratory (S).
- **If sample was spiked, with how much water (ppm):** If the sample was spiked, indicate in parts per million (ppm) the amount of water with which the sample was spiked. Indicate an "NA" if the sample was not spiked.

For each testing method performed for the sample (Aquatest 8, Pall TD513, or VaporPro), indicate the following:

- **Time to Complete Analysis (min.):** Indicate the amount of time in minutes to complete analysis of the sample.
- **Equipment Preparation Time Required (min.):** Indicate the amount of time in minutes to prepare the sample equipment to run the sample. For example, the

Aquatest 8 method requires equipment stabilization; indicate how long it took to stabilize the Aquatest 8 equipment.

- **Water Content (ppm):** Indicate the resulting water content in parts per million (ppm).
- **Oil Temperature:** Indicate the temperature of the oil while the test was being conducted. If the testing method does not display oil temperature, indicate the water content in “percent moisture” in the oil temperature column. Indicate which unit is displayed: °F, °C, or % moisture.
- **Volume and Type of Consumables Needed (mL):** List the consumables needed to perform the analysis and include the volume used in milliliters (mL).
- **Volume and Type of Waste Generated (mL):** List the waste generated by performing the analysis and include the volume generated in mL. Wastes may include remainder of oil sample, spent reagents, and other types such as lab ware.
- **Analyst Comments:** Indicate any comments, general and specific, that pertain to the condition of the water analyzer, how it is running, how it could be improved or made more efficient, and any other applicable/relevant comments.

### **3.2.2 *Instructions for Completing the Maintenance, Repair, and Cleaning Log (Table L2)***

- **Laboratory:** Identify which laboratory was conducting the analysis when maintenance, repair, or cleaning was required.
- **Date:** Indicate the date on which maintenance, repair, or cleaning was performed on the analyzer equipment.
- **Unit:** Indicate which analyzer needed maintenance, repair, or cleaning (i.e., Aquatest 8, Pall TD513 hand-held, or VaporPro).
- **Description of Maintenance, Repair, or Cleaning:** Describe what maintenance, repair, or cleaning was performed on the equipment.
- **Equipment Downtime:** Indicate how long in hours the equipment was out of service.
- **Parts or Materials Required:** Indicate what parts or materials were required to maintain, repair, or clean the equipment and include the volume of materials used in mL.
- **Scheduled Maintenance or Cleaning:** Indicate whether or not the required maintenance or cleaning was scheduled in accordance with the equipment manual.
- **Time Spent:** Indicate the man-hours spent maintaining, repairing, or cleaning the equipment.

## **4.0 REPORTING**

The final report will include detailed results and observations, assess the efficiency and cost-effectiveness of the unit, and evaluate its transferability to operational squadron sites. In order to generate the final report, data will be collected from Navy laboratory personnel. The Laboratory Water-in-Oil Analyzer Data Sheet (Table L1) and the Maintenance, Repair, and Cleaning Log (Table L2) should be completed by laboratory personnel every day that the water analyzers are used, checked, cleaned and/or serviced.

Data sheets should be faxed or e-mailed as they are completed or on a monthly basis at a minimum. Communications should be directed to the contacts below.

<b>Contact:</b>	Raymond Wendrzycki	Geneen McQuaid
<b>Location:</b>	NAVAIR Lakehurst, NJ	UTRS
<b>Address:</b>	Naval Air Warfare Center Aircraft Division, Code 4822 Route 547 Lakehurst, NJ 08733-5130	950 North Kings Highway Suite 208 Cherry Hill, NJ 08034
<b>Phone:</b>	732-323-1666 or DSN 624-1666	856-667-6770, x132
<b>Fax:</b>	732-323-4179	856-667-7586
<b>E-mail:</b>	Raymond.wendrzycki@navy.mil	gmcquaid@utrs.com

**TABLE L1**  
**LABORATORY WATER-IN-OIL ANALYZER DATA SHEET**

**Laboratory:** \_\_\_\_\_

Date	Analyst	Sample ID	Type of Oil	Type of Sample (F/H/S*)	If Sample Was Spiked, With How Much Water (ppm)

\*Mark an "F" if the sample came from the fleet, an "H" if the sample came from the HTFPU program, and "S" if the sample was spiked.

Method	Time to Complete Analysis (min.)	Equipment Preparation Time Required (min)**	Water Content (ppm)	Oil Temperature (indicate units)	Volume and Type of Consumables Needed (ml)	Volume and Type of Waste Generated (ml)***
Aquatest 8						
Pall TD513						
VaporPro						

\*\*For example, how much time was spent stabilizing the equipment?

\*\*\*Wastes include remainder of oil sample, waste reagents, lab ware, etc.

Analyst Comments: \_\_\_\_\_

Fax or e-mail to Raymond Wendrzycki at (732) 323-4917 or [raymond.wendrzycki@navy.mil](mailto:raymond.wendrzycki@navy.mil), or  
Geneen McQuaid at (856) 667-7586 or [gmcquaid@utrs.com](mailto:gmcquaid@utrs.com)

**TABLE L2**  
**MAINTENANCE, REPAIR, AND CLEANING LOG**  
**WATER-IN-OIL ANALYZER**

**Laboratory:** \_\_\_\_\_

<b>Date</b>	<b>Unit*</b>	<b>Description of Maintenance, Repair, or Cleaning</b>	<b>Equipment Downtime (hours)</b>	<b>Parts or Materials Required (indicate volume [mL])</b>	<b>Scheduled Maintenance or Cleaning? (Y or N)</b>	<b>Time Spent (man-hours)</b>

\*Indicate whether the Aquatest 8, the Pall TD513 hand-held, or the VaporPro water-in-oil analyzer needed maintenance, repair, or cleaning.

***NOTE: If the Pall hand-held water analyzer or the VaporPro moisture analyzer requires repairs, it should be arranged through Geneen McQuaid, UTRS, Inc., (856-667-6770, x132) or Raymond Wendrzycki (732-323-1666 or DSN 624-1666).***

**Fax or e-mail to Raymond Wendrzycki at (732) 323-4917 or raymond.wendrzycki@navy.mil and Geneen McQuaid at (856) 667-7586 or gmcquaid@utrs.com**